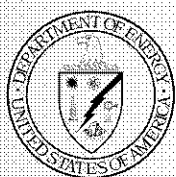

**Pacific Northwest
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**Sampling and Analysis Plan for
Two New Wells at BC Cribs,
200-PO-1 Operable Unit,
200 East Area,
Calendar Year 2005**

B. A. Williams
J. W. Lindberg

February 2005



Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Hanford Groundwater
Performance Assessment Project

**Sampling and Analysis Plan for
Two New Wells at BC Cribs,
200-PO-1 Operable Unit, 200 East Area,
Calendar Year 2005**

February 2005

Approvals

Technical Leads:	Bruce Williams	_____	Date:	_____
	Jon Lindberg	_____	Date:	_____
Task Lead:	Stuart Luttrell	_____	Date:	_____
Quality Engineer:	Tom Walker	_____	Date:	_____

Summary

This sampling and analysis plan (SAP) specifies data to be collected in association with drilling two new *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) groundwater monitoring wells downgradient of the BC Cribs in calendar year (CY) 2005 on the Hanford Site. This document specifies the activities for data collection to assure the data and associated measurement errors are appropriate to meet the quantitative and qualitative needs of the Groundwater Performance Assessment Project (groundwater project).

The justification for the new wells can be found in the *Data Quality Objectives Summary Report for Establishing a RCRA/CERCLA/AEA Integrated 200 West and 200 East Area Groundwater Monitoring Network* (CP-15329). The installation of the wells has been approved via Tri-Party Agreement (Ecology et al. 1989) Milestone M-24-57.

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1.0 Objective

The objective of this sampling and analysis effort is to collect sediment and groundwater samples, geophysical logs, and aquifer test data from the newly installed boreholes for use in updating the site hydrogeology, developing site conceptual flow models, and to support groundwater detection monitoring downgradient of the BC Cribs. The sediment samples and geophysical logs will be used to evaluate formation materials in the vadose zone and uppermost aquifer. The aquifer test results will be used to evaluate the hydraulic properties of the aquifer. The groundwater samples will be used to identify vertical constituent concentrations and help delineate the vertical distribution of potential contaminants.

2.0 Well Locations and Well Construction

The new wells will be drilled downgradient of the BC Cribs, located south of the 200 East Area on the Hanford Site. The well locations are shown on Figure 1. The new well PO-1 is located approximately 122 m (400 ft) northeast of the 216-E-14 crib. Well PO-2 is located approximately 274.32 m (900 ft) south of PO-1 and is approximately 350.52 m (1,150 ft) east of the 216-B-23 Crib. The exact well locations will be staked by the Pacific Northwest National Laboratory (PNNL) project scientist.

New well PO-1 will be drilled to the top of the Ringold Lower Mud unit (Unit 8) or 36.6 m (120 ft) below the water table (which ever is shallowest) for an estimated total depth of 141.7 m (465 ft). New well PO-2 will be drilled to an estimated total depth of 117.3 m (385 ft). The water table is expected to be encountered at approximately 104.8 m (344 ft) below ground surface (bgs).

Both new wells will be screened at the water table. The new wells are to be constructed as resource protection wells as defined in WAC 173-160. Detailed requirements for well construction are in the Well Data Sheets from PNNL to the lead drilling and construction contractor.

3.0 Data Collection Activities

Data collection activities associated with drilling the new wells include the following:

- Geologic description of sediment encountered during drilling.
- Collection of sediment samples returned to the surface during drilling.
- Collection and analysis of groundwater samples during drilling.
- Water level measurements.
- Geophysical logging.
- Well development parameters (drawdown during pumping and recovery).
- Aquifer testing.
- Deviation survey to determine any borehole deviations caused by drilling.

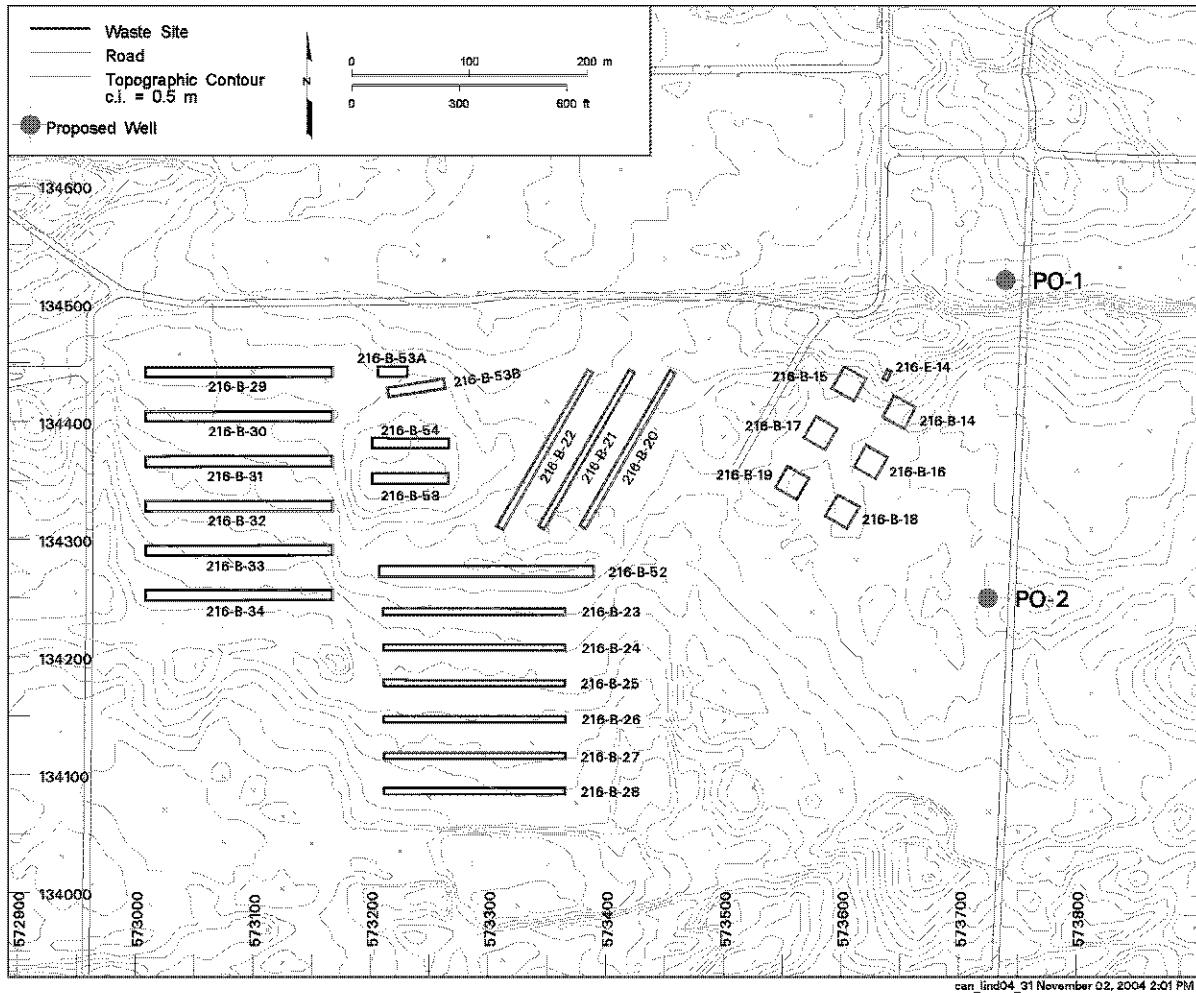


Figure 1. Location Map for Two Calendar Year 2005 Wells at BC Cribbs

3.1 Geologic Description

Continuous geologic description of drill cuttings will be logged. The purpose of the descriptions is to record the physical appearance and conditions of the vadose zone and saturated zone sediment to be used in developing conceptual models of subsurface hydrogeologic conditions. The geologic log will include descriptions of the following:

- Drilling conditions and changes in drilling conditions (e.g. drilling method, drill rate, addition of water, heaving sand).
- Depths of all collected samples.
- Lithologic descriptions of sediment.
- Water levels.

Approved procedures will be followed for geologic descriptions.

3.2 Collection of Sediment Samples

The purposes of the sediment samples are to (1) provide physical samples to aid geologist's description of lithologies, (2) provide a sample for future testing of physical or chemical properties as needed, and (3) provide an archive record of sediment samples encountered during drilling.

Representative sediment samples will be collected at 1.5-m (5-ft) intervals throughout the entire borehole. Additional samples will be collected at significant changes in lithology or at depths where unusual conditions or sediments are encountered. Samples will be collected in pint or quart glass jars capable of sealing existing moisture in the sample for a reasonable time period. If representative samples cannot be collected (for example, if large particles do not fit in the container), notes describing the condition of the sample will be put in the geologist's log. The samples will be archived in the Hanford Geotechnical Sample Library after collection. All sediment samples will be labeled with the borehole number, sample depth, and date of sample and documented on the geologist log.

In addition to the archived samples, small volume samples for chip trays will be collected.

No sediment samples will be collected from zones of subsurface contamination that would prohibit the uncontrolled transport of the samples to the Geotechnical Sample Library in the 300 Area. The presence or absence of contamination will be determined by field surveys using hand held instruments conducted by radiological control technicians or results from water sample analysis.

All sediment samples will be collected according to approved procedures. Chain-of-custody is not required for sediment samples.

3.3 Collection of Groundwater Samples

Groundwater samples will be collected during drilling only in well PO-1. Well PO-2 is not going to be drilled deep. A list of required analytes for each sample interval is presented in Table 1. Six groundwater samples will be collected from well PO-1 from the following depths: 6.1, 12.2, 18.3, 24.4, 30.5, and 36.6 m (20, 40, 60, 80, 100, and 120 ft) below the water table or until the Ringold Lower Mud unit is encountered (whichever is shallowest). The samples are to be representative, to the extent practicable, of the aquifer at the depth of the samples; therefore, the following collection method will be used.

The 6.1-m (20-ft) interval samples will be collected when drilling reaches that depth and then capturing the water that is either bailed or circulated through the return line at the surface (so called "blow and go" sampling). After drilling to each prescribed depth, the drill casing will be driven or maintained near the bottom of the drilled borehole to minimize borehole collapse and isolate the sample interval. The borehole will be cleaned of cuttings (by bailing or air circulation) prior to collecting the water samples. The water samples will then be captured from the water and sediment slurry that is either bailed or circulated to the surface.

The cognizant geologist at the borehole will collect the samples in clean and new 3.8-liter (1-gallon), wide-mouth containers with screw top lids labeled with the borehole number, sample depth, and date and time of collection. Three 1-gallon containers will be required for each sample interval. If insufficient water exists in the 6-m (20-ft) sample suite, the project scientist will prioritize the analytes. Groundwater samples will be turned over to the groundwater project after collection. The project will decant the

groundwater into the appropriate containers with preservatives. Because the samples will be a mixture of groundwater and sediment slurry, all samples will be filtered. Sample bottles, preservatives, and associated sample paperwork will be supplied by the groundwater project.

Samples will be sent to the groundwater project's contract laboratory. Measurements of specific conductance will be taken in the field at the time of sampling.

Groundwater samples will be collected according to this sampling plan and appropriately approved procedures. Chain-of-custody is required for all samples transported to the groundwater project's contract laboratories, but not required for field measurements. Instrumentation used during the collection of groundwater samples will be calibrated according to the manufacturer's procedures.

Table 1. Schedule for Collection of Groundwater Samples

Type of Sample	Sample Depths	Constituent	Analyzing Laboratory
New Well PO-1			
Depth discrete air-lifted or bailed sample	At depths of 6.1, 12.2, 18.3, 24.4, 30.5, and 36.6 m (20, 40, 60, 80, 100, and 120 ft) below the water table.	Anions	PNNL contract laboratory
		ICP metals	PNNL contract laboratory
		Gross alpha/beta	PNNL contract laboratory
		Gamma scan	PNNL contract laboratory
		Cyanide	PNNL contract laboratory
		Specific conductance	Field measurement
		Arsenic	PNNL contract laboratory
		Technetium-99	PNNL contract laboratory
		Strontium-90	PNNL contract laboratory
		Iodine-129	PNNL contract laboratory
		Tritium (high level)	PNNL contract laboratory
		Uranium (total)	PNNL contract laboratory
Vanadium	PNNL contract laboratory		
ICP = Inductively coupled plasma. PNNL = Pacific Northwest National Laboratory.			

3.4 Water-Table Measurements

Water-level measurements will be taken at several times during well drilling, construction, and development. The purpose of the measurements is to aid understanding of the hydraulic properties of the aquifer through which the borehole is drilled. These properties are used to (1) decide well construction details such as screen slot size, length and depth, and pump depth; (2) interpret aquifer flow direction; and (3) interpret subsurface contaminant movement.

The depth to water should be measured (1) as soon as possible after encountering the water table, (2) periodically throughout the day after drilling activities have stopped for some time (at a minimum, once in the morning prior to drilling and once in the evening before leaving the borehole for the day), (3) during well development to monitor drawdown, and (4) after well development to monitor recovery.

Water-level measurements will be monitored during drilling and construction activities and well development. Water-level measurements should be recorded to the nearest 0.003 m (0.01 ft).

3.5 Borehole Deviation Surveys

A borehole deviation survey will be conducted in each new borehole to evaluate the amount of deviation from vertical. The amount of deviation is used to make corrections to depth-to-water measurements and determine water-table elevations.

The deviation survey will be done with a down-hole gyroscope in each well prior to sample pump installation.

3.6 Geophysical Logging

Spectral gamma geophysical logging will be conducted in the new boreholes. The purpose of the logs is to determine the depth distribution of any gamma-emitting contaminants around the borehole and to interpret subsurface lithology. The borehole will be logged throughout the entire drilled depth.

Geophysical logging will be done according to appropriate approved procedures.

4.0 Aquifer Testing

Aquifer testing will be done in both of the completed wells following construction activities and will be coordinated by the PNNL hydrologic test team. These tests are independent of activities associated with drilling and construction of the new wells.

5.0 Well Screen Interval

The new wells will be completed at the water table with a 10.7-m- (35-ft-) long well screen consistent with existing detection monitoring network wells. When the new wells, screened at the water table, are added to the existing 200 PO-1 Operable Unit monitoring network they will improve detection monitoring for potential releases downgradient from the BC Cribs.

6.0 Analytical Testing

Chemical properties of groundwater samples will be tested at the groundwater project's contract laboratories. The quality assurance and quality control requirements for chain-of-custody, sample transportation, sample analysis, and data reduction, verification, and reporting will follow the requirements of the most recent revision of the project's quality assurance project plan.

All groundwater samples will be transferred to the groundwater project's contract laboratories. The analyses will be done according to approved laboratory standard operating procedures. Analysis of iodine-129 is accomplished by chemical precipitation and counting by low-energy photon detector. Analysis for tritium is done by distillation or electrolysis to enrich volume and liquid scintillation counting.

7.0 Project Organization and Responsibilities

The project scientist for BC Cribs is Mr. Jon Lindberg (376-5005). The technical point of contact for this project is Mr. Bruce A. Williams (372-3799).

PNNL is responsible for:

- This sampling plan.
- Preparation and delivery of the Well Data Sheet to the lead drilling contractor specifying well drilling, characterization (geophysical logging, aquifer and sediment sampling, and aquifer testing, etc.) and construction requirements.
- Scheduling for sample bottle preparation and preparing associated paperwork.
- Bottle preparation.
- Sample analysis and data validation and reporting of results.
- Decisions on pumping rate and sample collection activities.
- Modifications to this sampling and analysis plan as field conditions warrant.
- Aquifer testing design and implementation.

The lead drilling contractor is responsible for:

- Well site geologic activities.
- Collection of sediment samples.
- Collection of groundwater samples.
- Collection of water-level measurements.
- Conducting geophysical logging.
- Conducting gyroscope well deviation survey.
- Support to hydrologic testing activities.
- Health and safety at the drill site.
- Waste management at the drill site.

8.0 Health and Safety

The overall responsibility for field health and safety at drill sites belongs to the lead drilling contractor, who will assure that all applicable and required health and safety documentation, training, and practices

are up to date and complied with. Any activities done at the well site by PNNL staff will comply with the site health and safety plan. PNNL staff will also adhere to the requirements of internal safety rights and responsibilities procedures and policies.

9.0 Documentation and Records

Test conditions associated with sampling will be recorded by the well-site geologist. The water-level measurement and deviation survey data will be recorded by the lead drilling contractor or their subcontractors in accessible field forms and/or field notebooks. PNNL will obtain these data from the lead contractor or their subcontractors. When all data have been compiled, the test results will be reported as a letter or PNNL project document (e.g., Borehole Data Packages).

10.0 Changes

The project scientist, Mr. Jon Lindberg (376-5005), or his designee will provide specific direction to modify this sampling and analysis plan as field conditions warrant. These deviations will be recorded in the field forms and/or field notebooks.

11.0 References

Byrnes ME and BA Williams. 2002. *Data Quality Objectives Summary Report for Establishing a RCRA/CERCLA/AEA Integrated 200 West and 200 East Area Groundwater Monitoring Network*. CP-15329, Fluor Hanford, Inc., Richland, Washington.

Ecology - Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy. 1989. Hanford Federal Facility Agreement and Consent Order. Document No. 89-10, as amended (The Tri-Party Agreement), Olympia, Washington.

WAC 173-160. "Minimum Standards for Construction and Maintenance of Wells." *Washington Administrative Code*, Olympia, Washington.

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